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An Inaugural Essay

On the

Erectile Tissue

For the Degree of Doctor of Medicine

In the

University of Pennsylvania

By Joseph Pancoast

of New Jersey

February 22d 1827.

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Erectile Tissue

Erectile, derived from the Latin "erigere," to erect, or to stiffen, has been proposed by MM. Dupuytren & Rullier, as the name of the tissue, of which I am about to treat. Though important & interesting, in its functions & phenomena, it has until within a recent period, been little understood by Anatomists. The proposition has long known, that many parts of the animal economy, manifest in the exercise of their functions, a faculty of vital, expansion, directly at variance with the contractility which constitutes the peculiar mode of action of every other part. This active dilatation or erection is accompanied by an increased afflux of Blood through the arteries, which produces an interstitial turgescence of the tissue with a manifest increase in its volume. Under this name are enumerated the following parts, which are extremely analagous in function & in structure, as far as our gross senses, are permitted to investigate the delicacy of formation, which some of them possess. They exhibit the characteristic phenomena of this tissue, in the exercise of their respective offices. The Corpora, cavernosum and

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Spongiosum Penis, The Clitoris, the internal face of the Vulva and Vagina, in their common erections; The mammary Papillae, during the excretion of milk; The Iris, in its common offices in Vision; The Papillae of Touch & Taste, in their respective actions; The Intestinal villi in their function of absorption: The Fallopian Tubes, in their erection in coitus, to grasp the ova when they shall burst their Peritoneal enclosures; The Tissue of the Lips when under excitement; The Spleen; and several adventitious formations, as that form of "Nevi Materni" called Aneurism from Anastomosis by Mr Bell: various Polypi &c. &c. These parts resemble each other also, in their causes of excitation, in the temporary duration of their erection, in the production of pleasurable emotions, which have been thought by some their diagnostic distinctions, and in the greater degree of readiness, with which they respond to the action of indirect, than direct Stimuli. Thus we see erections to occur in the Penis, Clitoris &c. through the influence of the Imagination, which Mechanical irritation might be insufficient to excite. The Iris, contracts or dilates itself

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according to the presence or absence of rays of light upon the Retina, which have passed by its own surface without producing any effect: And the gustatory Papillæ erect themselves with Orgasm, when the olfactory organs are regaled with the smell of viands, which the Stomach desiderates. Barthez who first treated of this active dilatation, associated with it the expansive movements of the heart and a peculiar tissue which he supposed to exist in the skin, and to cause the Phenomena of blushing & that happy glow over the surface of the body, which is felt in a pleasing emotion. Also certain Zoophytes & some microscopical insects which undergo a dilatation when exposed to the action of heat & humidity: And the swelling of the anterior part of the neck, during the prevalence of Passion, and some of the hysteric affections.

This last fell under the observations of the Ancients, & that part of the neck received from them, the appropriate title of "πρηστης" from "πρηθω" to inflate.

The Penis by conventional agreement has been assumed as the type of the "Erectile Tissue" which exists within its structure in its greatest proportions.

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This organ is composed of two bodies the corpus cavernosum & corpus spongiosum, covered by a modified extension of the common integuments of the body: These bodies essentially composed of the erectile tissue, determine by the degree of their erection the circumference & length of this organ: The cavernous body arising by two crura from the ascending rami Ischiorum, seperated by the suspensory ligament of the Penis, quickly unite & form one body which has on its inferior side a groove for the body of the urethra. Its anterior portion is obliquely received into a cavity in the Glans Penis. Where the crura unite there is a continuation of the fasciæ above, which gives the body when stripped of its investing membrane the appearance of two crura laying side by side: As it proceeds downwards it is divided into parallel & vertical incisures, so as to permit the freest communication between the sides, & to entitle itself to the name of Septum Pectiniforme. This body is enveloped with a fibrous, white, & elastic sheath, which sends from its internal surface, little bridles, or prolongations, between which is placed, a tough, deeply red, gelatiniforme sub-

stance through which the minute ramifications numerically: This description is taken from the masculine organs of two geldings which I examined, & there is no doubt, but in the unemasculated horse, the vessels would have been still better developed. The sheath is pierced with holes for the passage of hypes, a part of which adheres is in contact with the spongy body. The principal arteries come from the internal pudic, & divide into two branches, the Dorsales & the Cavernosae. The first runs as its name indicates, and terminates at the Glans Penis. The Cavernosae pass on each side into the cavernous bodies under the Symphisis Pubis, and exhausts themselves in fine ramifications. The veins arise by small branches & unite themselves, mostly into one trunk in the human Penis, the Vena Dorsalis. In the horse I have found four or five, of the size of a finger forming a plexus, in which the whole organ seemed completely enveloped. The nerves in their number & magnitude, are perfectly in relation with the great sensibility of the part. They come from the sacral plexus. Upon the particular nature of the tissue, containing within the fibres innumerable filaments have variously divided,

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Vesalius in his work "De Corporis Humani fabricâ," lib. X Cap. XIV. Speaks of it in these words. "Corpora haec cavernosa nata ad eum fere modum, ac si ex innumeris arteriarum venarumque fasciculis quam tenuissimis, simulque proxime implicatis, retia quaedam efformarentur, orbiculatim a nervea illa membranosaque substantia comprehensa." Malpighi appears to have made an observation less correct. He says: "Sinuum speciem in mammarum tubulis, et in pene habemus: In his nonnihil sanguinis reperitur, ita ut videantur venarum diverticula, vel saltem ipsarum appendices." Ruysch, Haller, & even Bichat himself considered this tissue of a loose elastic cellular nature forming cells at the terminations of the arteries, into which during erection the blood was poured, & afterwards absorbed & carried away by the veins. These great Physiologists to have been so grossly deceived, must have derived their opinions from organs, dried, after the common cellular tissue of the part had been inflated, the Blood vessels effaced, and their gelatiniforme nidus evaporated. In this state it seems to present an appearance such as they describe.

Cuvier Rebes, in France, Mascagni, Farnese and Moreschi in Italy, & Tiedeman in Germany have shown by injections of the arteries & veins, that there are no cells or spongiform structure in the erectile tissue, but that it consists of minutely divided arteries & dilatable veins ramuscules, interwoven in the manner of capillary nets.

Jno Hunter remarked, the spongy bodies of the penis were not cellular, but consisted in a plexus of veins visible in the human subject, but still more so in the horse & other large animals. Cuvier states, the cavernous body in the Elephant's penis, is essentially composed of minutely divided veins, communicating with each other ad infinitum, that in a transverse section of the body, nothing could be seen but holes & meshes, and that the spaces which the vessels left among themselves were more contracted than their own orifices. The transverse fibrils, & the septum spectiniformes seem destined mainly to afford points of supports to the ramifying vessels: They may also assist to a certain extent, the locomotive coat in opposing a dilatation beyond a certain extent, thus preventing a varicose enlargement of the veins, which might otherwise ensue. The portion of the urethral body

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called spongy, commences with an oval enlargement of the size of a nut the bulb, & terminates in an expansion at the end of the penis, called the Glans, having its intermediate substance, much reduced in size, though its body throughout is analagous in structure. It is surrounded with a fibrous envelope & between it, and the mucous canal within, reposes the ramified Blood vessels. It is composed of a tissue precisely analagous with that of the cavernous body, & partakes with it in common its erection, tho they have sometimes it is said been seen, separate. The Glans appears to be more delicate in its structure, richer in blood vessels and more sensible in its functions: It has been found in some instances, isolated by a septum. The erection of this structure is never so firm & unyielding as that of the body of the penis, which may perhaps be accounted for by its perforation; to remedy this which might interfere with its function so it is placed in the centre of that body to be assisted by its firmer erection. There is a dimenution of this canal during an erection, which has been quoted by some as a proof of its muscularity. It is but a consequence of the erection of the spongy body and may be pro-

duced by an injection. From the concurrence of the several anatomists above, & from my own observations I am certain that the Corpus Spongiosum & Cavernosum, are entirely destitute of Spongy or cavernous structure, & should be called by terms, which would convey more adequate ideas of their structure. In the minutely divided arteries & dilatable veins then, the Phenomena of erection are produced, which it becomes me now to consider. That the principal use of this vascular tissue in the Penis is to produce its erection, is very evident, for in the Bear the Otter, the Badger, the Dog, its partial absence is supplied by a substitution of Bone. Upon the manner in which this Phenomenon is produced, the world has long has been divided: Of the theory which accounted for it by the contraction of the muscles of the Penis & the subsequent constrictions of the veins against the Symphysis pubis I shall only advert to speak of its insufficiency.

The attachment of the muscles in the first place, is unfavourable to perform completely such an office, & in the Second, they are endowed with Cerebral nerves and should act in obedience to the will: The con-

verse of which, is well known to be the case: Their office is evidently, to assist in the more common functions of the Penis: The contraction of the veins can be artificially produced, without compressing the arteries, yet erection will not be the result. Besides in the papillae of the breast, and in the Iris, we have true & genuine erection, when there are neither muscles to elevate, nor bones to constrict. Of another which presumes an extravasation of Blood & Spirits into the Spongy cells I need say less: As these cells have been proved to have no existence, save in the Imagination. Besides the disappearance of an erection is sometimes too sudden, to permit us to presume that the veins could have removed such a quantity of Blood so soon, by absorption. Moreschi having his attention accidentally directed to the erectile bodies has fairly proved, that it is essentially composed of vascular tissue: But at the same time he affects to deny, that the cavernous body is any thing more than tenacious cellular tissue, so circumstanced that the most delicate matter of injection can pass but a short distance into its cells, containing

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but a scanty proportion of blood vessels. This assertion astonishes the more, as the most superficial observation on the horse, is sufficient indubitably to contravert it. In the excision of this organ from the horse, I have seen at least a pint of venous blood discharged by a cut into the veins. Swammerdam & De Graaf assert that they cut the penis of a dog, during its erection & saw the organ regain its former rose & flaccidity, in proportion as the blood escaped from it. Moreschi has besides, failed to account for the erection of the Cavernous body: In what does the phenomena of erection consist?. All admit it to be produced by the collection of blood in the interior structure of the organ; induced by an increased afflux through the arteries, or by a constriction of the veins, or by both causes acting at the same time. Cuvier, who presumes that turgescence takes place in the dilated venous radicles, supposes it to be produced by a spasm of the dorsal veins, where it is intimately connected with the nerves: This is unsatisfactory: As it does not necessarily involve increased ca-

pillary action & without it we cannot explain the phenomena of erection, as the heat, the vermeil colour of the penis &c. Can we deduce any analogy, to warrant us in believing that the veins have an active dilatative power, a faculty of fabricating caloric? None. We find on the contrary, that the turgescence of the veins is always passive, and produces instead of a vermil, a livid, or at most a rosaceous colour, & has a tendency to diminish, rather than increase the caloric, to encumber more than enhance the sensations of a part, as we see in a hand when we hold it pendant, without stimulating the capillaries, while we turgesce the veins.

We are compelled to admit a dilatative or attractive power in the penis to invite the blood as the motions of the heart, during erection are known not to be accelerated. To the capillaries then we must recur for an explanation. Nature we know, throughout the whole of her harmonious circle, performs with every one of her elementary structures, operations intirely the same. Let me briefly examine them throughout

the System the functions of the capillaries & see if there be any analogy, in their common action with erection. Interposed ens where between th. arteries & veins, the seat of inflammation, of th. deoxydation of the blood, & calorification, of the secretion of some & the elimination of other fluids, we are naturally desirous of becoming acquainted with their structure, which is evidently fashioned with inherent powers, which the other systems are strangers: But here an objection is made to set at distance by their minuteness. By their functions, & by analogy alone can we arrive at any ideas of their structure. By function, in the manner in which they produce the circulation of Blood in the veins in a normal state, & by the production of Inflammation when abnormally excited; And by analogy in the resemblance of office in the circulation to the action of the heart. When we hold a hand to the fire, we perceive the capillaries instantly to dilate themselves & elevate the skin by exciting more blood to the part & to accelerate the motion of the Blood in the veins.

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Hodgson has shown that the anastomosing branches begin just to dilate themselves, at their capillary extremities, & in consequence of the unusual action of these last, an unusual degree of heat, is often excited in the limb. In animals whose horns have an annual growth, the capillaries of the part become excited & cause the arteries leading there, to enlarge without any increase in the propulsive power of the heart. The bad consequences of Inflammation here, do not result, for the arteries are relieved by the freedom of the secretion, which produces the rapid growth of the horns. The same thing occurs in the uterus during gestation, & the arteries here are relieved, by ministering to the necessities of the foetus. Many instances might be adduced, a few will answer my purpose: Every irritation we know to have the effect of accumulating blood, & to what agency can this be attributed but capillary action. Mental Influence we also see, can modify capillary action, as in the phenomena of blushing, the Suffusion of shame or the rage of Passion. When the hair gives itself up to its

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noble functions, who is there that knows himself that is not aware of the determination of blood to it, & does not feel its vivifying influence, to which the capillaries of the face & neck bear frequent witness. The influence which the capillaries exert in venous circulation is susceptible of many illustrations. In wounds which involve only the capillaries, the blood does not flow "per saltem," but trickles as it were in a sheet. This shows the influence of the heart there is nearly null, as we should presume it would be when the blood is divided into so many channels: The capillaries here exert the influence of another heart in giving the blood a gentle motion at the bottom of the column (or in the roots of the veins.) which becomes a considerable momentum when the blood is collected into a narrow channel in the venae cavae. The contractility of the veins may assist, but would not suffice to circulate the blood: And in the liver we perceive the contractility of the portal veins carrying the blood is directly opposed to that of the venae cavae hepaticae which return it.

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In the sinuses of the Brain, the contractility of the venous structure must be extremely feeble: Here with M. Broussais we must believe the capillaries give the blood a new impetus, which enables it to reach the heart.

How can we account for the circulation in some of the lower animals, which have perfect circulatory circles though deprived of a central organ, otherwise than by supposing that the capillaries move the blood through the vessels from tissue to tissue. How else can we account for the accumulations of blood which take place in chronic Inflammations, & shift from organ to organ, but by the respective excitations of the parts affected; We find hearts only in animals where the blood has to pass a great way without the aid of capillary vessels. In the more perfect plants, the fluids must be conducted in the same way.

It may be said that if we attribute this heart like action to the capillaries, we should prove them to have the same structure. Their minuteness renders this impossible. We know they possess the same lining membrane as the heart, for it is continued

through into the veins: The Yellow ligament of the arteries which takes its origin from the heart, terminates at the capillaries, for it is not found in the veins, offering therefore no resistance to the circulation of the capillaries, or of the heart. Cuvier has declared that in the Elephant he could perceive the arteries to contain more fibres & grow more red & muscular, as they approached their capillary extremities; thus giving one mode of accounting for capillary action. We all know the power of muscular fibre. We have seen what astonishing force a small Quantity can exert in the common Skipper, enabling it to spring many times its length. Anatomists have shown that the capillaries are rich in the nerves of organic life. The arteries seem to serve as conductors of the nerves to those vessels. Like the ventricles of the heart, the capillaries communicate on one side with the arteries on the other with the veins, for the auricles are but dilated veins united to the pericardium. We may also infer that like the ventricles they have their vasa vasorum or some

equivalent mode of nutrition. This may perhaps excite a smile, but closer investigation will I think show, that the difference between the Capillaries and the heart is not very great, when we view them respective actions, with regard to their difference in magnitude. We know that Mr Hunter injected the blood vessels of a bee, and there would hardly be reason in viewing them to be arteries & veins, because they were not so large as those of the Mastodon. The same process of reasoning then, which shall explain the actions of the heart, will suffice for those of the Capillaries. We well know what influence the passions exert over the heart and we can as readily conceive, how the mental affections should act on the Capillaries, so as to produce blushing in the face or erection in the Penis, as both are endowed with nerves from the same System. From what I have said I think it is very evident, that the Capillaries will form a proper Erectile tissue, wherever they shall have a disposition analagous to that in the Penis, Clitoris &c: That, is surrounded by a

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structure that will readily dilate on an increase of organic action within. In the spongy heads of the long bones, there is a cancellated structure, over which ramify the vessels. But this is not an erectile tissue; for when its vessels are abnormally excited, it is enable to dilate, its organic sensibility is exalted which reacts upon the Brain & pain is produced. But in the penis, we see the rise of the organ, to vary constantly, with the organic sensibility of the part: between its diminutiveness when exposed for a long time to the chill of a cold bath, to its evolution in a state of excitement.

It may be said, that by merging its action in the capillaries, it will have no claim to an arrangement as a tissue: But erection is the peculiar normal action of the part to which all others are subordinate, & for purposes highly important to the animal economy. The capillaries are only the effective agents. The same objection might be urged against the glandular system, in which the capillaries are the only instruments of action, and we see that it has individually the power of secreting lymph & pus.

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Did we not restrict ourselves in this way, we might go on, ad infinitum, until we should see, in the contraction of all our muscles, nothing but the chemical attraction of their component globules & the elasticity of the tissue which connects them. I will now conceive the stimulus to be applied to the penis which shall cause its erection, be it, natural, mechanical, chemical, or mental. The excitement is said by M. Broussais to be general throughout the capillary system, the mouth in extreme cases to be dry & parched & vivid sensations to be felt at the epigastrium.

The capillaries of the tissue instantaneously dilate, invite an increased quantity of blood into its structure & generate a considerable quantity of calorique:

The elastic involucrum expands itself chiefly passively by vascular distension, assisted perhaps by the distension its molecules will feel, in consequence of the calorique; the veins as they pass through the ligament become paralyzed by the effusion & permit their dilatable walls within to be distended by the increased action of the capillaries.

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appearance, which the veins have in this tissue at their origin: And M. Chauveau has remarked that the veins have at their origin throughout the System, a dilated appearance, resembling somewhat the erectile tissues: The fleshy part of the fingers where the sense of touch resides in a great state of perfection, shows this in an eminent degree. The temporary stimulation over, the elastic ligaments reacts, facilitate the expulsion of the blood from the veins, and the organ regains its former state & degree of sensibility. That the elastic coat may thus react Mr Shaw has fairly proved.

Having produced by injection the same degree of erection we have in Gonorrhea, he introduced a bougie into the urethra & found it ejected by the elasticity of the ligament with some force. In another experiment he threw into the canal a quantity of water, & found it ejected a distance nearly of two yards. A similar mode of action appears to me exist in all the erectile bodies, but to which my limits will not allow me to refer. Phenomena nearly Similar have been supposed by Dr Hays of this City to be developed in

the erection of the Iris. We well know the great number of capillaries which exist in this part, connected with the ciliary vessels: And we know also that if its proper stimulus light, be applied too vividly, or too long without intermission, that the abnormal irritation which ensues will produce its Inflammation, & vice versa.

By what other principle than erection can we account for the phenomena, which occur in some of the plants during their fructification. In the Passion flower for instance, the Passiflora Coerulea. when it has arrived at a state of maturation, we see the stamina one by one approach the pistil & depart from it for their anthers, the fecundating pollen, return to their former position & dwindle away. If the view I have taken be correct, then is but little difference between the erection of this tissue & the inspiency of Inflammation: As parts frequently inflamed are most liable to Inflammation again, so it is with this tissue, the more frequently it is excited into action the more subservient is it to stimulation. Let me reverse the picture, & see if common Inflammation in-

-duced in these parts by its ordinary causes is characterised by similar phenomena. A few words will suffice to prove it: In Priapism, & Satyriasis, it most undeniably exists, and in Nymphomania, as is well known to have been the case with the notorious Messalina.

Instances of this last are recorded in which females religiously chaste, & of immaculate character, have exhibited an appearance of disgusting depravity, & if it has gone on till it has deteriorated the functions, & jeopardised even the existance of life: Among the lower animals as the cow &c, which like plants, seem to have the power of fœcundating but at [illegible] period of the Year, the normal excitement of the genital parts, seems to be a state of regular Inflammations, eliciting uncontrollable desires. Habit in the penes, as in other parts under the influence of the nerves exerts her influence; The man accustomed to libidinous indulgences will have upon the least stimulation his erectile System, thrown into a State of excitement. The same principle of action exists in the determination of blood to the [illegible] &c. The

Phlegmatic man unaccustomed to the exercise of his mental faculties, but who tasks his other systems inordinately as the Stomach Liver &c, will have there all the action developed in fever. In the man of fancy and reflection on the contrary we often see little such excitement is sufficient to throw all the faculties of his brain into a state of ebullition.

Of the principle which presides over the erectility of this tissue we know but little & can never know much, till man be able to explain all the secrets of his mysterious Psychology. Whether we locate it with M. Gall in the Cerebellum or with M Bouillaud in the secretory organs of the semen we leave the riddle but half read, & 'tis perhaps in vain for man, to carry his abstractions further.

Such then appears to be the Phenomena of erection in the Penis & such as it occurs in the other erectile bodies, though somewhat modified perhaps, by its location; As interesting perhaps in their nature, as any which appear in the system, when viewed as they should be in a Philosophical light.

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I have ventured upon a field of difficulties, in which I have had few authors to guide me, and those few so dissonant among themselves, that I have been obliged to depend in a much greater degree than I wished upon my own resources.